Savannah River Site
Solid Waste Management Division
Consolidated Incinerator Facility
Operators Training Program

STEAM AND CONDENSATE SYSTEM (U)

Study Guide

ZIOITX11
Revision 03

Training Manager / Date

Engineering / Date

Facility Manager / Date

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REVISION LOG

	AFFECTED SECTION(S)	SUMMARY OF CHANGE
02	All	New Issue
03	All	Revised Objectives

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REFERENCES

1. 261-SOP-MST-01, *Main Steam and Condensate*, Rev. 3

2. Consolidated Incinerator Facility Functional Description, Main, Rev. 1

3. *OSOH Steam & Condensate System Drawing W830345*, Rev. 31

4. *WSRC 8Q Employee Safety Manual*, Item #61, "*Personal Protective Equipment*," Revision 2

5. WSRC-SA-17, *Consolidated Incinerator Systems Safety Analysis Report*, Chapter 6, DOE Approval Copy

6. WSRC-SA-17, *Consolidated Incinerator Systems Safety Analysis Report*, Chapter 9, DOE Approval Copy

7. *ZIOISX11 Steam and Condensate System Design Description*, Rev. 0

LEARNING OBJECTIVES

TERMINAL OBJECTIVE

1.00 Without references, **EXPLAIN** the importance of the Steam and Condensate System to Consolidate Incinerator Facility (CIF) operations. Discuss the safety concerns applicable to this system. Discuss the consequences of a system failure to overall CIF safety and plant operations.

ENABLING OBJECTIVES

1.01 **STATE** the purpose of the Steam and Condensate System.

1.02 **IDENTIFY** the personnel safety concerns associated with the Steam and Condensate System.

1.03 Briefly **DESCRIBE** how the Steam and Condensate System accomplishes its intended purpose.

1.04 **EXPLAIN** the consequences of a Steam and Condensate System failure. Include the potential effects in regard to personnel safety, system component response, associated system operations, and overall plant operations.

TERMINAL OBJECTIVE

2.00 Using diagrams, **EVALUATE** potential problems that could disrupt routine Steam and Condensate System operations. Ascertain the problem significance to continued system operations. Determine the corrective actions required to restore routine plant operations.

ENABLING OBJECTIVES

2.01 **DESCRIBE** the physical design of the Steam and Condensate System. Sketch a one line diagram including the following system components and interrelationships with associated systems:

a. regulating valves
b. safety valves
c. bypass valves
d. instrumentation
e. connections to and from associated systems

2.02 **DESCRIBE** the operational design of the Steam and Condensate System. Discuss the basic construction, principles of operation, specific system component functions, and locations within the system. Describe the following:

a. regulating valves
b. safety valves
c. bypass valves
d. instrumentation
e. steam traps

2.03 Given the system configuration and system equipment status, IDENTIFY and **EXPLAIN** those conditions which could potentially obstruct routine system operations. Discuss the corrective actions that would need to be taken in order to reestablish normal system operations.

TERMINAL OBJECTIVE

3.00 Given operational parameters for the Steam and Condensate System, **ANALYZE** those parameters for the presence of potential problems or trends which could effect system operations. Determine the significance of the resultant conditions and determine also the actions required to restore the system to normal.

ENABLING OBJECTIVES

3.01 **STATE** the design and operational parameters of the following Steam and Condensate System components:

a. regulating valves
b. safety valves
c. bypass valves
d. instrumentation

3.02 Given operational parameters and key performance indicators of the Steam and Condensate System, **EVALUATE** the given conditions to determine if the system and system components are functioning properly within required specifications.

3.03 **DESCRIBE** the Steam and Condensate System instrumentation. Within the system, discuss the instrument locations, instrument sensing points, and output control signals associated with individual instruments. Describe the following:

a. pressure indicators
b. flow indicators
c. temperature indicators
d. differential pressure indicators

3.04 **INTERPRET** the Steam and Condensate System alarms. Interpret both the actuating conditions causing the alarms and the basis for the alarms within the system. Interpret the alarms provided by the following system instrumentation.

3.05 **EXPLAIN** the controls of major components within the Steam and Condensate System. Discuss the different component manipulations involved during various operational modes and conditions. Determine the components normal controlling station either local or control room. Discuss the principles of operation behind the component controlling devices. Discuss component controls for the following system equipment:

a. regulating valves
b. safety valves
c. bypass valves
d. steam traps

3.06 **DESCRIBE** the interlocks associated with the Steam and Condensate System. Describe the conditions that will trigger the system interlocks, the effects of interlock actuation for both the Steam and Condensate System and CIF, and the design basis behind each individual interlock. Discuss the interlock actuated by the following system instrumentation:

a. pressure indicators
b. flow indicators
c. temperature indicators
d. differential pressure indicators

TERMINAL OBJECTIVE

4.00 **DEMONSTRATE** both problem recognition and problem resolution. Given a set of current system parameters, the necessary Steam and Condensate System operating procedures, and system technical documentation, DETERMINE the required operator actions in both normal and off normal operational situations.

ENABLING OBJECTIVES

4.01 Given the applicable Steam and Condensate System procedures and plant conditions, **DETERMINE** the actions necessary to perform the following system evolutions:

a. Startup
b. Normal operations
c. Shutdown

4.02 **DETERMINE** both the specific effects to the Steam and Condensate System and the general overall integrated plant response to all of the following:

a. abnormal system indications
b. plant or system alarms
c. operator initiated actions
d. component malfunctions
e. component failures

SYSTEM OVERVIEW

Introduction

The Steam and Condensate System is an integral part of the CIF, providing support services for other CIF systems. The Steam and Condensate System consists of three (3) pressure systems (High Medium, and Low Pressures) which serve various plant loads and utility hose stations. Condensate collected through steam traps is directed to Catch Basin No. 4, which ties into the Storm Sewer System.

ELO 1.01	**STATE the purpose of the Steam and Condensate System.**

System Purpose

The purpose of the CIF Steam System is to provide steam to serve the process system and meet building heating requirements. The Steam System supply provides four (4) separate systems within the CIF:

- Incineration System (Rotary Kiln [RK] Burners, Secondary Combustion Chamber [SCC] Burners and RK Aqueous Waste [AQW] nozzle for atomization and vaporization of liquid wastes and fuel oil prior to incineration)
- Offgas System (Offgas Scrubber, Offgas Reheater, SCC and Quench Vessel expansion joints)
- Tank Farm System (clean and regulated unloading areas to assist in the unloading of the caustic and liquid wastes)
- Building HVAC System (to the preheat coils to warm building air during the heating season)

ELO 1.02	**IDENTIFY the personnel safety concerns associated with the Steam and Condensate System.**

Safety

Steam is very hazardous because of its high temperatures and pressures. Pressurized steam is stored energy that can perform considerable work or cause extensive damage if released in an uncontrolled manner. High-energy steam must be controlled at all times.

When working near steam lines, it is essential that proper safety equipment be worn and proper precautions be taken. To prevent injury in the event of a piping failure, steam component malfunction, or steam blowdown, operators and other personnel in the immediate vicinity must comply with safety precautions in accordance with Manual 8Q, *Employee Safety Manual*, Item 61 *(Personal Protective Equipment)*. Steam blowing from vents and drains can also be extremely loud and could present a hearing hazard; therefore, earplugs will be worn when working near steam systems.

To prevent system overpressure conditions, safety valves (pressure relief devices) are installed to open rapidly on overpressure and remain open until a specified pressure drop has occurred. If a safety valve failed to operate, the results could be devastating because the steam line itself could rupture or other system components could fail, providing the potential for injury or death. Periodic inspection and testing of these valves is critical to ensure the operability of their intended function at all times.

Steam traps can also be hazardous if they malfunction. Hot condensate and flying debris could cause injury. Hot condensate is a burn hazard, so personnel should familiarize themselves with steam trap locations and distance themselves from steam traps and blowdown lines when the traps are expelling condensate. If a burn should occur, the injured person should rinse the affected area with cool water and seek medical attention immediately. The supervisor of the injured person will be notified as soon as possible after the incident.

Water hammer is another adverse condition associated with steam systems. Water hammer is caused by: 1) flashing water into steam as the steam flows through a line containing pockets of condensate; 2) steam being condensed by the water and creating a vacuum in piping, followed by more steam rapidly filling the void; and 3) the physical shock that occurs when water is entrained with steam. These conditions will depend on the temperatures and volume of the steam and water. Water hammer is identified by noise and vibration along with a distinct banging as the entrained water impinges itself upon system piping and components.

Water hammer can damage steam piping to the point of causing component leakage and/or system rupture. To avoid conditions that could cause water hammer, condensate must be thoroughly drained from lines prior to the admission of steam. Steam valves must be opened slowly, adequate warmup time must be ensured (normally no less than 30 minutes, but the time varies with steam line size), and blowdown drains must be kept open until only dry steam is emitted. Care should be taken when walking near steam trap french drains; hot condensate can "puddle" and contribute to burns on feet or legs, if inadvertently stepped in.

Investigating a steam system for steam leaks is one if the corrective actions performed on the receipt of a low-pressure alarm. A steam leak can cause the low-pressure alarm if the steam station is unable to make up for the escaping steam. To check for steam leaks, operators walk down the steam piping looking for a steam plume or the noise of escaping steam. Care should be taken not to use hands to locate steam leaks, as high-pressure steam can cause serious injury. If a steam plume is not immediately seen, a plan should be developed to locate the leak. The operator should take a thermograph or use some other type of device to locate the leak, as escaping superheated, high-temperature steam may not be visible.

Responsibilities

The Site Utilities Department, Area Power Operations Group, is responsible for the production of export steam to end users such as the CIF.

CIF operators are responsible for the operation of the steam lines and valves which tap off the main export line downstream of CIF steam system isolation.

Prior to placing the CIF Steam and Condensate System in service, the Area Power Operations Group must be notified that an additional demand will be placed on the existing Site Steam System.

Summary

- The purpose of the CIF Steam System is to provide steam to serve process systems and meet building heating requirements.

- The steam supply provides steam to four (4) separate systems within the CIF:
  - RK and SCC Burners and RK AQW nozzle
  - Offgas Scrubber, Reheater and SCC/Quench Vessel expansion joints
  - Tank Farm Clean and Regulated Unloading Areas (to assist in the unloading of the caustic and liquid wastes)
  - Building HVAC System (to warm the building air)

- Steam is very hazardous because of its high temperatures and pressures. Pressurized steam is stored energy that can perform considerable work or cause extensive damage if released in an uncontrolled manner.

- Water hammer is a hazardous condition associated with steam systems. Water hammer can damage steam piping to the point of system rupture and/or component failure.

- CIF operators are responsible for the operation of the steam lines and valves which tap off the main export line downstream of CIF steam isolation valves.

MAJOR COMPONENTS

1.03	**Briefly DESCRIBE how the Steam and Condensate System accomplishes its intended purpose.**

Introduction

The CIF Steam and Condensate System is supplied from an export steam header that originates in H Area and courses to DWPF in SArea. The CIF 4-inch Outside Overhead (OSOH) header taps off the existing export steam header upstream of the DWPF and approximately 25 yards east of the CIF Emergency Diesel Generator buildings. The 4-inch header goes to Building 261-H. Export steam is supplied at 300 psig. There it is reduced to 180 psig and 30 psig to facilitate various facility loads. Steam traps are dispersed throughout the system to remove condensate from the system lines. The High-, Medium-, and Low-Pressure Steam Systems are protected from overpressure conditions by their associated safety valves.

1.04	**EXPLAIN the consequences of a Steam and Condensate System failure. Include the potential effects in regard to personnel safety, system component response, associated system operations, and overall plant operations.**

System Loads

Each steam subsystem has certain loads (equipment, traps, etc.) which require a portion of the steam in order to fulfill their prescribed functions. (See Figure 1, *Steam Distribution System*.)

High-Pressure Steam - 300 psig

- Offgas scrubber high-pressure steam via an eductor generating a high velocity mix of scrubber solution and Offgas

- Medium-pressure steam header via dual, parallel-pressure reducing valves (H-261-MS-PV-5852, H-261-MS-PV-5853)

Medium-Pressure Steam - 180 psig

- Offgas reheater medium-pressure steam to raise the process offgas temperature to above its dew point

- SCC Fuel Oil Burner atomizing, purge, and seal steam

- SCC ROW Burner atomizing, purge, and seal steam

- RK Fuel Oil Burner atomizing, purge, and seal steam

- RK Liquid Waste Burner atomizing, purge, and seal steam

- RK Aqueous Waste nozzle atomizing, purge, and seal steam

- Low pressure steam header via dual, parallel-pressure reducing valves (H-261-LS-PV-5856 and H-261-LS-PV-5857)

Atomizing steam breaks up the fuel oil, aqueous waste, and liquid waste to facilitate a more effective vaporization and incineration. Purge steam is used to expel condensate prior to a system startup and to clean out the liquid feed lines following a shutdown Sealing steam is used to isolate the opening when removing guns from the burner.

Low-Pressure Steam - 30 psig

- Utility hose station on the SW corner of Tank Farm near Blend Tank #1

- Utility hose station on the platform next to rad oil/solvent unloading pump at the SE corner of Tank Farm

- Utility hose station at the Fuel Oil and Caustic Unloading Area for the heating of caustic in a tanker truck

- Reduced pressure continuous steam purge to the SCC and quench vessel expansion joints via pressure reducing valve (H-261-LS-PV-2406)

- Building 261-H HVAC Unit preheating coil and five (5) area unit heaters

Condensate

- Collects the condensate accumulated from header steam traps and directs it to the french drains and Service Water Tank (SWT) Condensate discharging from the 30 psig steam header to the expansion joints is piped into the SCC where it is evaporated.

2.01	**DESCRIBE the physical design of the Steam and Condensate System. Sketch a one line diagram including the following system components and interrelationships with associated systems:** **a. regulating valves** **b. safety valves** **c. bypass valves** **d. instrumentation** **e. connections to and from associated systems**
2.02	**DESCRIBE the operational design of the Steam and Condensate System. Discuss the basic construction, principles of operation, specific system component functions, and locations within the system. Describe the following:** **a. regulating valves** **b. safety valves** **c. bypass valves** **d. instrumentation** **e. steam traps**

System Components

High-Pressure Steam

- 3006FV - (H-261-HS-FV-3006) Scrubber inlet control valve, 4", A/O, DCS controlled, set to maintain 15,000 lb./hr flow

Moderate-Pressure Steam

- 5852PV (H-261-MS-PV-5852) & 5853PV (H-261-MS-PV-5853) - duplicate inlet pressure regulating valves, 2", setpoint 180 psig

- 3401TV-1 (H-261-MS-TCV-3401-(A) & 3401TV-2 (H-261-MS-TCV-3401-(B) - duplicate Reheater inlet temp control valves, 1 1/2", A/O, DCS controlled maintaining 240°F at Reheater outlet gas temperature

- 2212HV (H-261-MS-FV-2212) - SCC Fuel Oil atomizing steam block valve, 1", A/O, solenoid actuated, BMS PLC controlled

- 2204PV (H-261-MS-PCV-2204) - SCC Fuel Oil atomizing steam control valve, 1/2", A/O, DCS controlled through 2204PR (H-261-MS-CNV-2204) by 2204PC (H-261-MS-PIC-2204) to maintain greater than 25 psig above fuel oil pressure

- 2605HV (H-261-MS-FV-2604) - SCC Fuel Oil steam purge valve, solenoid actuated, A/O, 1/2”, pushbutton controlled on DCS

- 2311HV (H-261-MS-FV-2311) - SCC ROW atomizing steam block valve, 1”, A/O, solenoid actuated

- 2304HV (H-261-MS-PCV-2304) - SCC ROW atomizing steam control valve, 1/2”, A/O, DCS controlled, set to maintain greater than 25 psig above fuel pressure

- 2704HV (H-261-MS-FV-2704) - SCC ROW steam purge valve, solenoid actuated, A/O, 1/2”, DCS controlled via pushbutton

- 1516HV (H-261-MS-FV-1516) - RK Fuel Oil Burner atomizing steam block valve, A/O, 1”, solenoid actuated, BMS PLC controlled

- 1515PV (H-261-MS-PV-1515) - RK Fuel Oil atomizing steam pressure reducing valve, 1/2”, setpoint 113 psig

- 1504PV (H-261-MS-PCV-1504) - RK Fuel Oil atomizing steam control valve, A/O, 1/2”, DCS controlled, set to match steam pressure at same pressure of fuel oil up to 100 psig; difference between two pressures cannot be more than 5 psig above RK Fuel Oil pressure

- 1804HV (H-261-MS-FV-1804) - RK Fuel Oil steam purge valve, A/O, 1/2” solenoid actuated, DCS controlled by pushbutton

- 1617HV (H-261-MS-PCV-1604) - RK Liquid Waste atomizing steam control valve, 1/2”, A/O, DCS controlled, set to maintain pressure at 120 psig

- 1904HV (H-261-MS-FV-1904) - RK Liquid Waste steam purge valve, A/O, 1/2”, solenoid actuated, DCS controlled by pushbutton

- 2020HV (H-261-MS-FV-2020) - RK Aqueous Waste atomizing steam block valve, 1”, A/O, solenoid actuated, BMS PLC controlled

- 2008PV (H-261-MS-PCV-2008) - RK Aqueous Waste atomizing steam control valve, 1”, A/O, DCS controlled, set to maintain pressure at 120 psig

- 2015HV (H-261-MS-FV-2015) - RK Aqueous Waste steam purge valve, 1/2”, A/O, solenoid actuated, DCS controlled by pushbutton

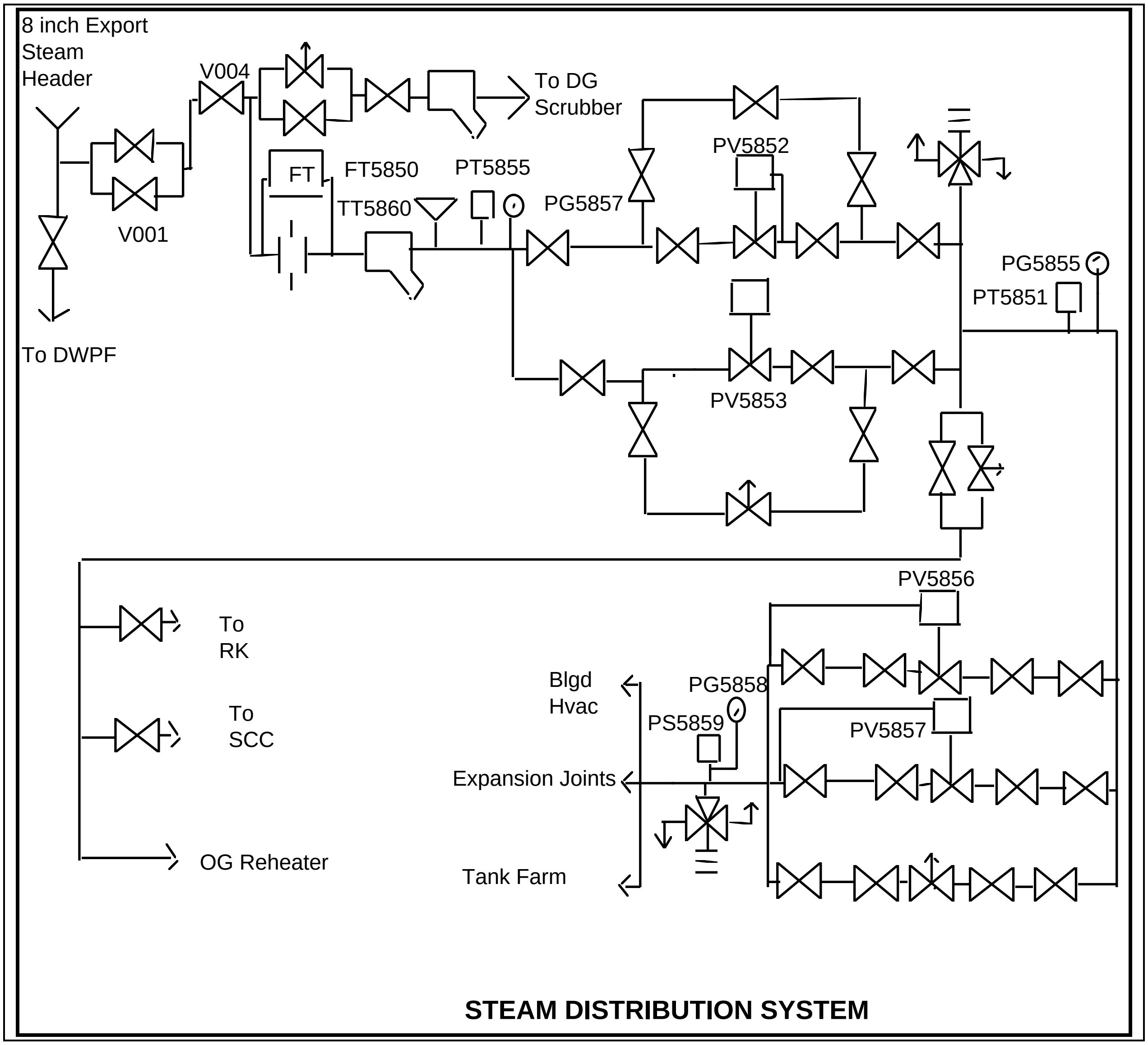

Figure 1 CIF Steam Distribution System

System Flowpath

High-Pressure Steam

After the high-pressure steam line taps off the export steam line from H Area, it ascends to grade elevation near the Emergency Diesel Building and enters a piping culvert. The supply line exits the culvert adjacent to Building 261-H, where a 4-inch leg branches from the supply line to the medium pressure reducing station. The high-pressure steam line is routed over the control building roof and runs east to west, parallel with the liquid waste feed lines coming from the Tank Farm.

This high-pressure steam pipe is sealed with a blind flange at the end of the line behind the process HEPA filters near the Drum Receiving and Shipping Area. This line supplies a 4-inch leg which runs northward and passes through a flow control valve adjacent to the Offgas Quench Vessel, supplying 300 psig steam to the Offgas Scrubber. A strainer and trap tap off to route condensation to a catch basin.

Medium-Pressure Steam

The line which branches off the main header to the medium-pressure reducing station (located on the east side of Building 261-H) contains flow, temperature, and pressure transmitters. All transmitters provide input into the DCS. The pressure switch will activate an alarm on low-line pressure.

The medium-pressure reducing station (Figure 1, *CIF Steam Distribution System*) has two pressure reducing valves (PRVs) in parallel legs which reduce the pressure to 180 psig. A pressure relief valve downstream of the PRVs is set at 200 psig to provide system overpressure protection. A pressure switch on the discharge side of the PRVs activates an alarm on high or low system pressure. Pressure gauges upstream and downstream of the PRVs provide operators with available local indications.

After the reducing station, the medium-pressure header is routed over the roof of the Control Building where it runs parallel to the high-pressure steam line. The medium-pressure piping header end is sealed with a blind flange near the Drum Receiving and Shipping Area. Three 2-inch lines supply steam to the Offgas Reheater, the RK Remote Burner Skid, and the SCC Remote Burner Skid after branching off the medium-pressure header.

Steam to the Reheater travels through two parallel temperature control valves prior to branching into three(3) lines which supply the reheater coils.

Steam from the RK Remote Burner Skid is used by the RK Fuel Oil Burner, RK Waste Liquid Burner, and Aqueous Waste Nozzle. Steam from the SCC Remote Burner Skid is used by the SCC Fuel Oil Burner and SCC Rad Organic Waste Burner. Steam is used by the RK and SCC for atomization, purging, and sealing. Steam is used in the Offgas System in the Offgas Reheater to raise the process offgas temperature to above its dew point.

Low-Pressure Steam

Downstream of the medium-pressure reducing station, a 2-inch pipe branches from the medium-pressure steam line to supply the low-pressure reducing station. Two PRVs are provided in parallel to reduce the steam pressure from 180 psig to 30 psig. A bypass throttle valve is also included, around the two PRVs, to provide a means for a controlled warmup of the Low-Pressure System prior to placing the system in service. (See Figure 1, *CIF Steam Distribution System.*)

A pressure relief valve, a dual pressure switch, and a pressure gauge are located downstream of the pressure reducing valves. The pressure relief valve is set at approximately 35 psig, providing overpressure protection. The pressure switch provides input to DCS. The 2-inch line is increased to a 3-inch line downstream of the relief valve and is routed over the control building roof, descending to a point just north of the regulated entrance to the building. The line then branches off with one leg entering the Container Handling Area. After the low-pressure steam line enters the Container Handling Area, a 2-inch supply line feeds 30 psig steam to the building ventilation system air unit and five (5) area unit space heaters. The other leg of the 3-inch line runs parallel to the high-and medium-pressure headers to the Tank Farm Area. While still in Building 261-H, this leg branches off to a 1-inch line which supplies low-pressure steam to the expansion joints for the SCC and Quench Vessel. (See Figure 2, *Quench Vessel Expansion Joints.*)

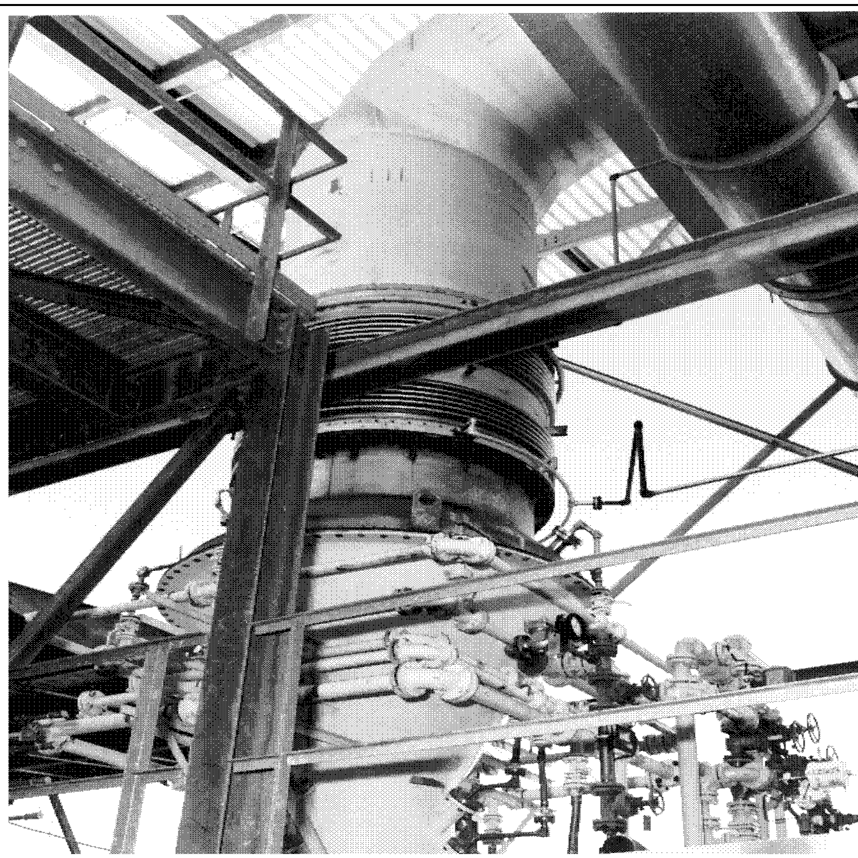

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Figure 2 Quench Vessel Expansion Joints

In the Tank Farm Area, the end of the 3-inch line is sealed with a blind flange. Three 1-inch lines branch from the 3-inch supply header to supply 30 psig steam to three utility hose stations. One hose station is located on an overhead platform at the southeast end of the Tank Farm next to the rad oil/solvent unloading pump (Figure 3, *Tank Farm Steam Locations*). Another hose station is located at the Clean Unloading Area where steam is used to heat caustic within the tanker truck before being offloaded. The other hose station is located on the southwest side of the Tank Farm adjacent to Blend Tank #1.

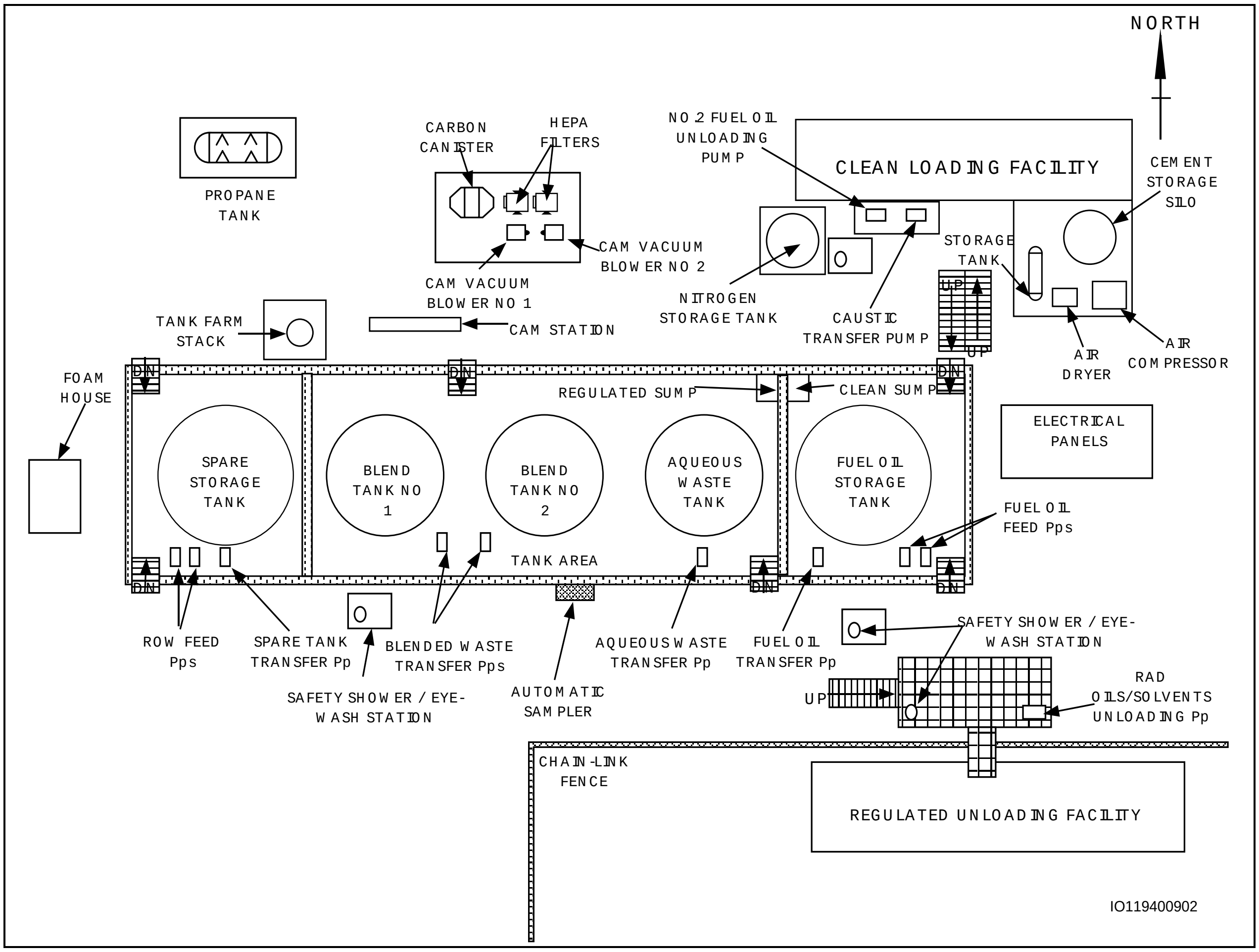

Figure 3 Tank Farm Steam Locations

Condensate

Condensate which is collected through steam traps is routed to the french drains. A 1-inch condensate drain header attaches to the high-pressure steam system supply header. The Medium-Pressure Steam System provides two (2) condensate drain headers; one to the french drains and the other to the Service Water Tank (SWT). There is a 1 1/2-inch line which is a collection of all atomizing steam trap drains from all the RK and SCC burners. Offgas Reheater traps drain to a 1-inch line. The Low-Pressure Steam System is provided with three condensate drain lines to the french drains and SWT. There is a 2-inch line from the Building HVAC Steam Heating System and two 1-inch lines from the low-pressure header trap drains.

Summary

- The CIF Steam and Condensate System is supplied from an export steam header that originates in H Area. The CIF 4-inch OSOH header taps off the existing export steam header ≈ 25 yards east of the CIF emergency diesel generator buildings. The 4-inch header goes to Building 261-H at 300 psig. It is reduced to 180 psig and 30 psig to accommodate various facility loads. Steam traps are dispersed throughout the system to remove condensate from the steam system lines. The High-, Medium-, and Low-Pressure Steam Systems are protected by relief valves from overpressurization.

- Collected system condensate is directed to the french drains and the SWT.

INSTRUMENTATION & CONTROL

3.02	**DESCRIBE the Steam and Condensate System instrumentation. Within the system, discuss the instrument locations, instrument sensing points, and output control signals associated with individual instruments. Describe the following:** **a. pressure indicators** **b. flow indicators** **c. temperature indicators** **d. differential pressure indicators**

Pressure Indicators

Information from pressure gauges will aid operators in maintaining the Steam System within normal operational pressure bands. Pressure indicators are substantial because they aid operators in system monitoring and problem identification. The most common type of indicator is the pressure gauge. Pressure indicators can be used to provide input to control air-operated reducing valves and provide alarms to indicate abnormal system conditions.

Flow Indicators

Flow indicators are used to determine if the proper flow rate is being delivered to system components. It is a problem indicator if the flow rate is not within predetermined limits.

Flow rates are determined by measuring the differential pressure across a flow restriction device. This restriction can be a venturi or an orifice. As the flow changes through the restriction, the differential pressure across the restriction also changes. The flow instruments are calibrated to read the flow rate that corresponds to an associated differential pressure.

Temperature Indicators

Temperature indication is commonly used in steam systems to measure the temperature of components heated by the steam. This temperature can be used to control the amount of steam to the components while maintaining the desired temperature. It can also be used to secure steam to a component if temperatures become excessive.

Differential Pressure (DP) Indicators

The DP indicators are often used in determining flow through a particular component. They are commonly used with filter elements to determine if the filter is fouled, needing cleaning, or possible replacement.

3.01	**Given operational parameters and key performance indicators of the Steam and Condensate System, EVALUATE the given conditions to determine if the system and system components are functioning properly within required specifications.**
3.03	**INTERPRET the Steam and Condensate System alarms. Interpret both the actuating conditions causing the alarms and the basis for the alarms within the system. Interpret the alarms provided by the following system instrumentation.**

High Pressure Steam

The following instrumentation is provided in the High-Pressure Steam System for indication, control, and alarm functions:

Pressure

- 3007PT (H-261-HS-PT-3007) - Scrubber inlet pressure 0-300 psig, DCS indication and low-pressure. alarm (200 psig)
- 3008PG (H-261-HS-PI-3008) - Local scrubber inlet pressure gauge, 0-400 psig
- 5851PG (H-261-HS-PG-5851) - Local header pressure gauge, 0 - 400 psig
- 5855PT (H-261-HS-PT-5855) - Header pressure 50-350 psig, DCS indication, low-pressure alarm (230 psig), flow calculation and incinerator shutdown S/D interlock

Flow

- 5850FT-1 (H-261-HS-FT-5850) - Total steam header flow except scrubber flow, 0-5000 lb/hr, input to totalizer for flow calculation
- 3006FT (H-261-HS-FT-3006) - Scrubber steam flow, 0-300 inwc, 7500 lb/hr input to 3006FC (H265-3006-FC) for scrubber steam flow control; input to 5861FT-1 [H-261-HS-FT-5861-(A)] for calculation of total steam flow, 5861FG-1 (H-261-HS-FI-5861-(B) for indication; Incinerator S/D interlock; Low-Flow Alarm (7000 lb/hr); Low-Low Flow Alarm (6000 lb/hr)

Temperature

- 5860TT (H-261-HS-TT-5860) - Steam header temperature, 350-600°F, DCS input for indication 5860TG (H-261-HS-TI-5860) and for calculation of total steam flow

Medium-Pressure Steam

The following instrumentation is provided on the Medium-Pressure Steam System for indication, control, and alarm functions:

Pressure

- 5851PS (H-261-MS-PS-5851) - Steam header pressure switch, DCS High/Low alarm (190 psig increasing/175 psig decreasing)

- 2204PT (H-261-MS-PT-2204) - SCC Fuel Oil Remote Burner skid atomizing steam pressure, 0-200 psig, DCS input to steam/Fuel Oil DP controller 2204PC (H-261-MS-PIC-2204)

- 2206PS (H-261-MS-PDS-2206) - SCC Fuel Oil Remote Burner skid steam/SCC Fuel Oil DP switch, DCS High/Low alarm (35/25 psig), low DP control

- 2207PG (H-261-MS-PI-2207) - SCC Fuel Oil Remote Burner skid atomizing steam pressure gauge, 0-300 psig

- 2202PS (H-261-MS-PS-2202) - SCC Fuel Oil Remote Burner skid atomizing steam pressure switch, High/Low DCS alarm (150/50 psig)

- 2618PG (H-261-MS-PI-2618) - Local SCC Fuel Oil Burner atomizing steam pressure, 0-200 psig

- 2306PG (H-261-MS-PI-2306) - Remote SCC ROW Burner skid atomizing steam pressure gauge, 0-300 psig

- 2307PS (H-261-MS-PS-2307) - Remote SCC ROW Burner skid atomizing steam/SCC ROW DP switch, High/Low DCS alarm (40/20 psig) and control

- 2310PS (H-261-MS-PS-2310) - Remote SCC ROW Burner skid atomizing steam pressure switch, High/Low DCS alarm (110/25 psig)

- 2718PG (H-261-MS-PI-2718) - Local SCC ROW Burner atomizing steam pressure gauge, 0-300 psig

- 1506PS (H-261-MS-PSLL-1506) - RK Remote Burner skid Fuel Oil atomizing steam pressure switch, High/Low DCS alarm (130/80 psig) and control

- 1507PG (H-261-MS-PI-1507) - RK Remote Burner skid Fuel Oil atomizing steam local pressure gauge, 0-300 psig

- 1504PT (H-261-MS-PT-1504) - RK Remote Burner skid Fuel Oil atomizing steam pressure transmitter, 0-200 psig, input to DCS for steam/fuel oil DP controller 1504PC (H-261-MS-PIC-1504)

- 1502PS (H-261-MS-PS-1502) - RK Remote Burner skid Fuel Oil atomizing steam pressure switch, High/Low DCS alarm (110/5 psig)

- 1818PG (H-261-MS-PI-1818)- Local RK Burner Fuel Oil atomizing steam pressure Gauge, 0-300 psig

- 2012PS (H-261-MS-PS-2012) - RK Remote Burner skid Aqueous Waste atomizing steam pressure switch, High/Low DCS alarm (150/80 psig)

- 2010PG (H-261-MS-PI-2010) - RK Remote Burner skid Aqueous Waste atomizing steam pressure gauge, 0-300 psig

- 2008PT (H-261-MS-PT-2008) - RK Remote Burner skid Aqueous Waste atomizing steam pressure transmitter, 0-200 psig, input to Aqueous Waste/Steam DP controller 2008 PC (H-261-MS-PIC-2008) and low-pressure alarm (90 psig), panel 2405B, recorder input 1604PC (H-261-MS-PR-1604)

- 2011PS (H-261-MS-PSLL-2011) - RK Remote Burner skid Aqueous Waste atomizing steam pressure switch, High/Low DCS alarm (150/80 psig) and control

- 2018PG (H-261-MS-PI-2018) - Local RK Aqueous Waste Burner nozzle atomizing steam pressure gauge, 0-300 psig

- 1604PT (H-261-MS-PT-1604) - RK Remote Burner skid Liquid Waste atomizing steam pressure transmitter, 0-200 psig, input to DCS for Liquid Waste/Steam DP controller 1604PC (H-261-MS-PIC-1604), and low pressure alarm (90 psig), panel 2405B, recorder 1604C (H-261-MS-PR-1604) input

- 1606PG (H-261-MS-PI-1606) - RK Remote Burner skid Liquid Waste atomizing steam local pressure gauge, 0-300 psig

- 1610PS (H-261-MS-PS-1610) - RK Remote Burner skid Liquid Waste atomizing steam pressure switch, High/Low DCS alarm (135/100 psig)

- 1607PS (H-261-MS-PS-1607) - RK Remote Burner skid Liquid Waste atomizing steam pressure switch, High/Low DCS alarm (150/80 psig)

- 1918PG (H-261-MS-PI-1918) - RK Liquid Waste Burner local atomizing steam pressure gauge, 0-300 psig

Flow

- 2210FT (H-261-MS-FT-2210) - SCC Remote Burner skid Fuel Oil atomizing steam flow transmitter, 0-100 IN WC, DCS input for indication 2210FG (H-261-MS-FI-2210) and alarm (20 lb./hr)

- 2301FT (H-261-MS-FT-2301) - SCC Remote Burner skid ROW atomizing steam flow transmitter, 0-100 IN WC, DCS input for indication 2301FG (H-261-MS-FI-2301) and alarm (12.6 lb./hr)

- 1510FT (H-261-MS-FT-1510) - RK Remote Burner skid Fuel Oil atomizing steam flow transmitter, 0-200 lb./hr, DCS input for indication 1510FG (H-261-MS-FI-1510) and alarm (12.6 lb./hr)

- 1601FT (H-261-MS-FT-1601) - RK Remote Burner skid Liquid Waste atomizing steam flow transmitter, 0-200 lb./hr, DCS input for indication 1601FG (H-261-MS-FI-1601) and alarm (20 lb./hr)

- 2013FT (H-261-MS-FT-2013) RK Remote Burner skid Aqueous Waste atomizing steam flow transmitter, 0-100 IN WC, DCS input for indication 2013FG (H-261-MS-FI-2013) and alarm (40 lb./hr)

Low-Pressure Steam

The following instrumentation is provided on the Low-Pressure Steam System for indication, and alarm functions.

Pressure

- 5859PS (H-261-LS-PS-5859) - Low-pressure header pressure switch, DCS High/Low alarm (33 psig increasing/25 psig decreasing)

- 5858PG (H-261-LS-PI-5858) - Low-pressure local header pressure gauge, 0-60 psig

Condensate

The Condensate System has no instrumentation associated with it. Cndensate may be directed to the french drains or to the Process Water Tank.

Summary

- The High-, Medium-, and Low-Pressure Steam Systems use pressure, flow, temperature, and differential pressure instruments for both monitoring and control functions.

CONTROLS, INTERLOCKS, & LIMITS

3.05	**DESCRIBE the interlocks associated with the Steam and Condensate System. Describe the conditions that will trigger the system interlocks, the effects of interlock actuation for both the Steam and Condensate System and CIF, and the design basis behind each individual interlock. Discuss the interlock actuated by the following system instrumentation:** **a. pressure indicators** **b. flow indicators** **c. temperature indicators** **d. differential pressure indicators**

Interlocks

- G38 - Incinerator S/D occurs following a low-pressure condition on the high-pressure steam supply header at 230 psig processed by 5855PT pressure transmitter via DCS.

- E16 -Wastes Feed S/D occurs following a low scrubber steam flow condition at 6000 lb/hr and is processed by 3006 FT via DCS.

- Atomizing steam block valves to:

  - RK FO BRNR (1516 HV)

  - RK BW BRNR (1617 HV)

  - RK AQW NOZ (2020HV)

  - SCC FO BRNR (2212 HV)

  - ROW BRNR (2311 HV)

  are interlocked open when:

  - RK/SCC exit temperatures are > 1000°F

  - steam purge is selected

  - FO/waste is ready to be admitted

- C245 - Auto BW stream S/D on a steam header LP condition at 80 lb. processed by 1607 PS via DCS.

- C106 - Auto ROW stream S/D on a steam/ROW header DLP condition at 20 psid processed by 2307 PS via DCS.

- Auto AQW stream S/D on a steam header LP condition at 80 psig pressed by 2011 PS via DCS.

- Auto Reheater steam S/D* on a reheater exhaust gas exiting temperature high at 265°F via DCS.

* shuts TCV3401(A) and TCV3401(B)

Limits

The rate of temperature rise when steam is introduced to the steam line should be limited to a maximum of 100°F/hr.

Accepted industry practice is to open the bypass valve around the block valve very slowly (1/4 to 1/2 turn at a time), repeating as necessary to equalize system pressure (two or three times), and then opening the bypass fully. The trap bypasses are allowed to blow free until the steam lines reach operating temperatures (~4-6 hours). After the desired system temperature is reached, the bypasses around the block valves and trap bypasses are shut. The main valve is then slowly opened to the "full open" position and taken off its backseat one full turn.

The rate of temperature decrease in the Steam System is normally governed by the rate at which temperature drops as the steam condenses in the system lines. Minimizing this decrease prevents thermal stresses from damaging piping and piping supports.

Setpoints

The setpoints, setpoint descriptions, and tag numbers for the Steam Systems are listed in Appendix A, *Steam System Setpoints*.

Summary

- CIF Steam System interlocks are designed to protect the facility personnel and equipment in the event that system limits are exceeded.

SYSTEM INTERRELATIONS

Introduction

The steam supply provides steam to four (4) separate systems within the CIF:

- Offgas System (Offgas Scrubber, Offgas Reheater, SCC and Quench Vessel expansion joints)
- Tank Farm System (clean and regulated unloading areas to assist in the unloading of the caustic and liquid wastes)
- Incineration System (RK Burners, SCC Burners, and the RK AQW nozzle for atomization and vaporization of liquid wastes and fuel oil prior to incineration)
- Building HVAC System (to the preheat coil for warming building air during the heating season)

2.03	**Given the system configuration and system equipment status, IDENTIFY and EXPLAIN those conditions which could potentially obstruct routine system operations. Discuss the corrective actions that would need to be taken in order to reestablish normal system operations.**

Offgas System

The Offgas System is used to cool the offgas exiting the SCC and to provide scrubbing and filtration actions to neutralize acid gases and to remove entrained particulate matter from the exiting incineration gases.

The Steam System interfaces with the Offgas System in the Steam Eductor of the Offgas Scrubber. Steam at 300 psig is supplied to the eductor to generate a high velocity mixing of the scrubber solution and the offgas. Scrubbing liquid and caustic are introduced at the eductor throat where a sonic shock wave is developed. The shock wave breaks up the scrubbing liquid into fine droplets which capture particulates down to the sub-micron range and absorb acidic gases. The liquid droplets coalesce in a mixing tube into larger droplets which are removed in the downstream cyclone separator. The steam flow rate to the Scrubber is controlled in a range of 10,000-15,000 lb/hr, and the scrub liquid is injected through the eductor nozzle at a rate of approximately 37 gpm.

Steam at 175 psig is provided to the Offgas Exhaust System Reheater (Figure 4, page 32, *Offgas Exhaust System Reheater*) to increase offgas temperature, typically from 190°F to 240°F. This prevents condensation from occurring in the downstream carbon steel ductwork or process HEPA filters. The reheater steam supply is provided with redundant control valves so that routine maintenance can be performed on one of the valves while allowing continued systems operations with the other valves on service. The condensed steam from the reheater coils is returned to the Service Water System (SWS) via the condensate collection system piping.

Tank Farm

Steam is used at the Clean Unloading Facility (Figure 3, *Tank Farm Steam*) as a means of keeping caustic in solution when temperatures are to the point at which caustic begins to precipitate out of solution. The heating of the caustic facilitates the efficient offloading of the caustic from a tanker to the Caustic Storage Tank.

Incineration (RK and SCC) System

The Steam System supplies atomizing and sealing steam to the RK burners, the SCC burners, and the Rotary Kiln AQW nozzle. This steam provides sealing for the nozzles when removing a gun for maintenance and also atomizes the waste liquids for efficient vaporization and combustion.

Building HVAC System

The Steam System supplies steam to the preheating coils of the HVAC System to heat air entering the CIF during the heating season.

Summary

- The steam supply provides steam to the following systems:
  - Offgas
  - Tank Farm
  - Incineration (RK and SCC) Systems
  - Building HVAC
- The Offgas System is used to cool the offgas exiting the SCC and uses steam to provide scrubbing and filtration to both neutralize and remove particulates from the exiting offgas.
- Steam is used in the Tank Farm as a means of keeping caustic in solution and to facilitate unloading operations.
- Steam is used in the Incineration System for atomizing, sealing and purging of the RK and SCC guns.
- Steam is supplied to the HVAC System for heating the CIF.

INTEGRATED PLANT OPERATIONS

4.01	**Given the applicable Steam and Condensate System procedures and plant conditions, DETERMINE the actions necessary to perform the following system evolutions:** **a. Startup** **b. Normal operations** **c. Shutdown**

Principles of Operation

During normal steady state operations, steam system components play a vital role in process operations and act to maintain the system in a safe condition. System operators will perform routine surveillances to help ensure continued proper operation of system components and system integrity. System startup and shutdown are critical periods.

System Startup

A startup evolution is the most critical period in the operation of any Steam Distribution System. The CIF Steam System will be started up in accordance with procedure 261-SOP-MST-01, *Main Steam and Condensate*. This procedure must be followed verbatim to prevent possible catastrophic system failures caused by thermal shock or water hammer.

The first step prior to placing a steam distribution line on service is to shut all line load isolation valves. This is done to prevent equipment/systems from receiving steam before normal temperatures and pressures are reached inside the header, thereby preventing large amounts of condensate from entering system equipment. The next step is to fully open all blowdown valves (drains) on the steam header purging all condensate and air from the header.

To prevent serious thermal shock to steam piping, it is very important that the line be brought up gradually, minimizing thermal stresses in the piping and components by allowing a sufficient warmup period. The time required for the warmup is dependent on the header diameter, length, number of free blows, and the range of steam system operating pressures and temperatures. The standard time for a header warmup should be a minimum of 30 minutes in duration. On high-pressure lines, the warmup period will be at least one hour. Some intra-area export lines take several hours to warm to temperature.

Water hammer is prevented or lessened by adequate warmup periods and sufficient blowdowns of the steam pipe during the startup. Condensate not removed can cause any number of problems ranging from increased pipe wall erosion, impingement damage to system components, or possible steam line failure brought on by severe water hammering. A brief synopsis of a typical steam system startup is as follows:

- Shut or check shut all valves supplying associated steam loads.
- Fully open all blowdown (drain) valves on the steam header.
- Crack open the steam header isolation valve or the isolation valve bypass. (The header isolation valve will usually have a small bypass valve for warmup purposes.)
- Monitor the blowdown drains for condensate flow.
- When steam issues from the blowdown drains and no water is present, close the blowdown valves (beginning with the blowdown valves closest to the steam source).
- If steam traps are provided in the steam header, place those traps on service and monitor the traps for proper operation.
- Monitor the steam line high-point vents for steam flow.
- When the condensate and air are completely expelled from the steam header and steam is issuing from the vents, close the vents starting with those closest to the steam source.
- The steam header pressure is then gradually brought up to normal operating pressures.
- Once at pressure, the steam header isolation valves are now opened fully.
- It is good engineering practice to inspect the system for signs of leakage and abnormal conditions as the header is being pressurized and placed into service.

3.04	**EXPLAIN the controls of major components within the Steam and Condensate System. Discuss the different component manipulations involved during various operational modes and conditions. Determine the components normal controlling station either local or control room. Discuss the principles of operation behind the component controlling devices. Discuss component controls for the following system equipment:** **a. regulating valves** **b. safety valves** **c. bypass valves** **d. steam traps**

Normal Operations

High Pressure Steam Header

The high-pressure steam header is monitored by the DCS for steam temperatures and pressures. OSOH steam flow is metered and combined with the scrubber steam flow measurement to indicate total steam flow. At 200 psig in the steam header, a low-pressure alarm is activated, as well as an Incinerator S/D Interlock.

Scrubber Steam Flow

The DCS controls high-pressure steam flow to the scrubber through a solenoid-operated control valve and monitors both steam flow and system pressure to the scrubber eductor. DCS provides a Low-flow alarm at 7000 lb./hr. At 6000 lb/hr a Low-Low flow alarm and Incinerator S/D Interlock occurs. A system Low-pressure alarm will activate at 200 psig. Normal system steam flow is maintained in a range of 10,000-15,000 lb./hr. A high temperature condition at the scrubber gas outlet (210°F) will automatically keep the scrubber steam supply valve closed.

Medium Pressure Steam Header

The medium-pressure steam header is monitored by the DCS via a High/Low-pressure switch which alarms at 190 psig and 175 psig, respectively.

Reheater Steam

DCS controls the medium-pressure steam flow to the reheater (Figure 4, *Offgas Exhaust System Reheater*) through either of two selected temperature control valves. Steam to the unit is controlled by monitoring reheater gas outlet temperature and maintaining a normal operating temperature setpoint of ~240°F. A High-High outlet gas temperature alarm at 265°F will act automatically to close the steam supply valves.

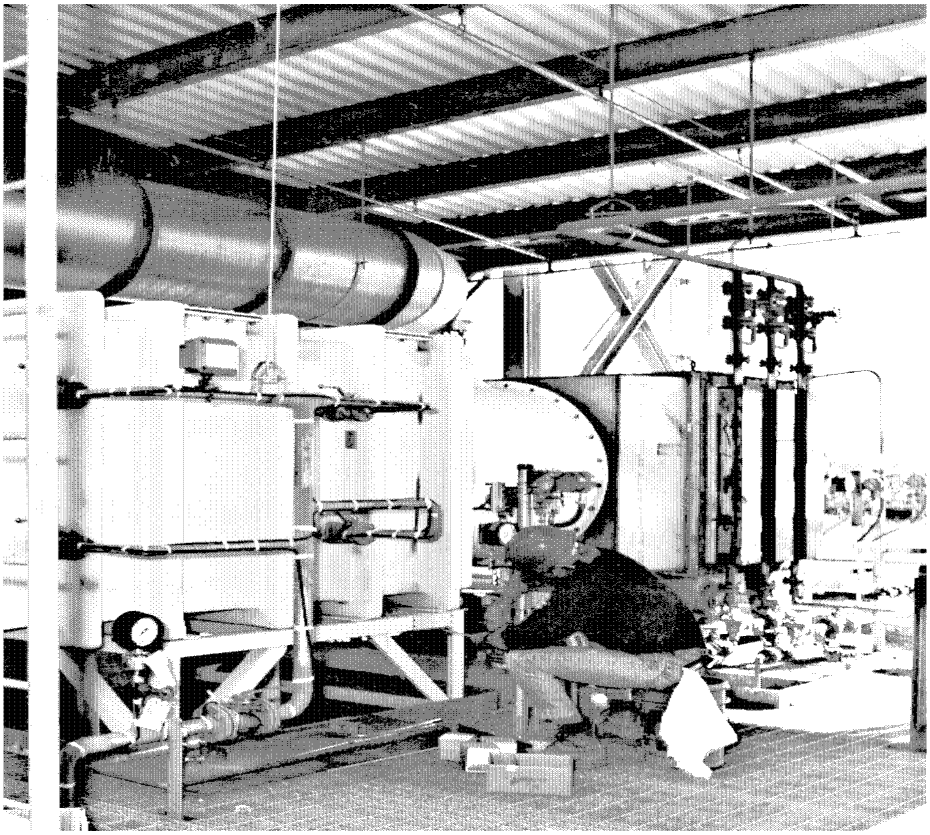

Figure 4 Offgas Exhaust System Reheater

SCC Fuel Oil Burner

Pressure and flow of atomizing steam to the SCC fuel oil burner is monitored by the DCS. Monitoring instruments are located in the steam lines at the SCC remote skid.

Pressure and flow instrumentation send signals to the DCS, which in turn control steam pressure and flow. The DCS also controls the differential pressure between the atomizing steam and fuel oil. The DCS provides the following alarms and controlling actions:

CONDITION	ALARM	CONTROL ACTION
Press ≥ 150 psig	Hp Alarm	
Press ≤ 50 psig	Lp Alarm	
30 psid		Nominal regulating differential between steam and F.O.
≤ 25 psid	Low Dp Alarm	
≥ 35 psid	High Dp Alarm	
Flow ≤ 20 lb/hr	Low Flow Alarm	

Table 1 SCC Steam/Fuel Oil

DCS also provides for control of purge steam used for clearing condensate from and cleaning of the fuel oil line. When the purge valve is manually selected, DCS closes a fuel oil block valve and opens the steam purge valve. Steam and fuel oil valves used during purging are located at the SCC fuel oil local skid.

Burner seal steam is provided through the same control and blocking valve as the atomizing steam, but has no automatic or remote control features.

SCC ROW Burner

Pressure and flow of atomizing steam to the SCC Radioactive Organic Waste (ROW) burner is monitored by the DCS. Monitoring instruments are located in the steam lines at the SCC remote skid.

Pressure and flow instrumentation send signals to the DCS, which controls steam pressure and flow. The DCS also controls the differential pressure between the atomizing steam and the ROW. The DCS provides the following pressure and flow alarms and controlling actions:

CONDITION	ALARM	CONTROL ACTION
Press = 110 psig	Hp Alarm	
Press = 25 psig	Lp Alarm	
30 psid		Nominal regulating differential between steam and ROW
≤ 20 psid	Low Dp Alarm	Burner S/D on interlock
≥ 40 psid	High Dp Alarm	
≤ 12.6 lb/hr	Lo Flow Alarm	

Table 2 SCC Steam/ROW Pressure

DCS also provides control of the steam purge valve for the ROW burner. When “Steam Purge" purge is manually selected, the steam purge valve is opened, and the liquid waste block valve is closed.

Burner sealing steam is provided through the same steam control and block valves as atomizing steam (Figure 5, *Steam to SCC ROW Burner*), but has no automatic or remote control functions.

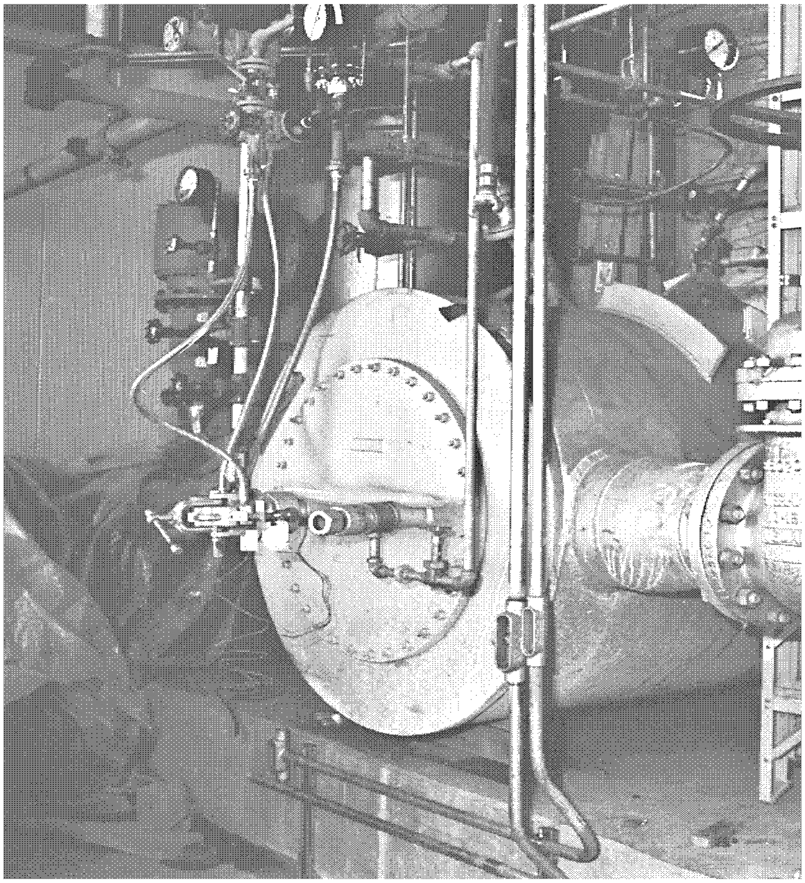

Figure 5 Steam to SCC ROW Burner

RK Fuel Oil Burner

Pressure and flow of atomizing steam to the RK fuel oil burner is monitored by the DCS, (Figure 6, *180 psi Steam to RK Fuel Oil Burner*). Monitoring instruments are located in the steam lines at the RK remote skid.

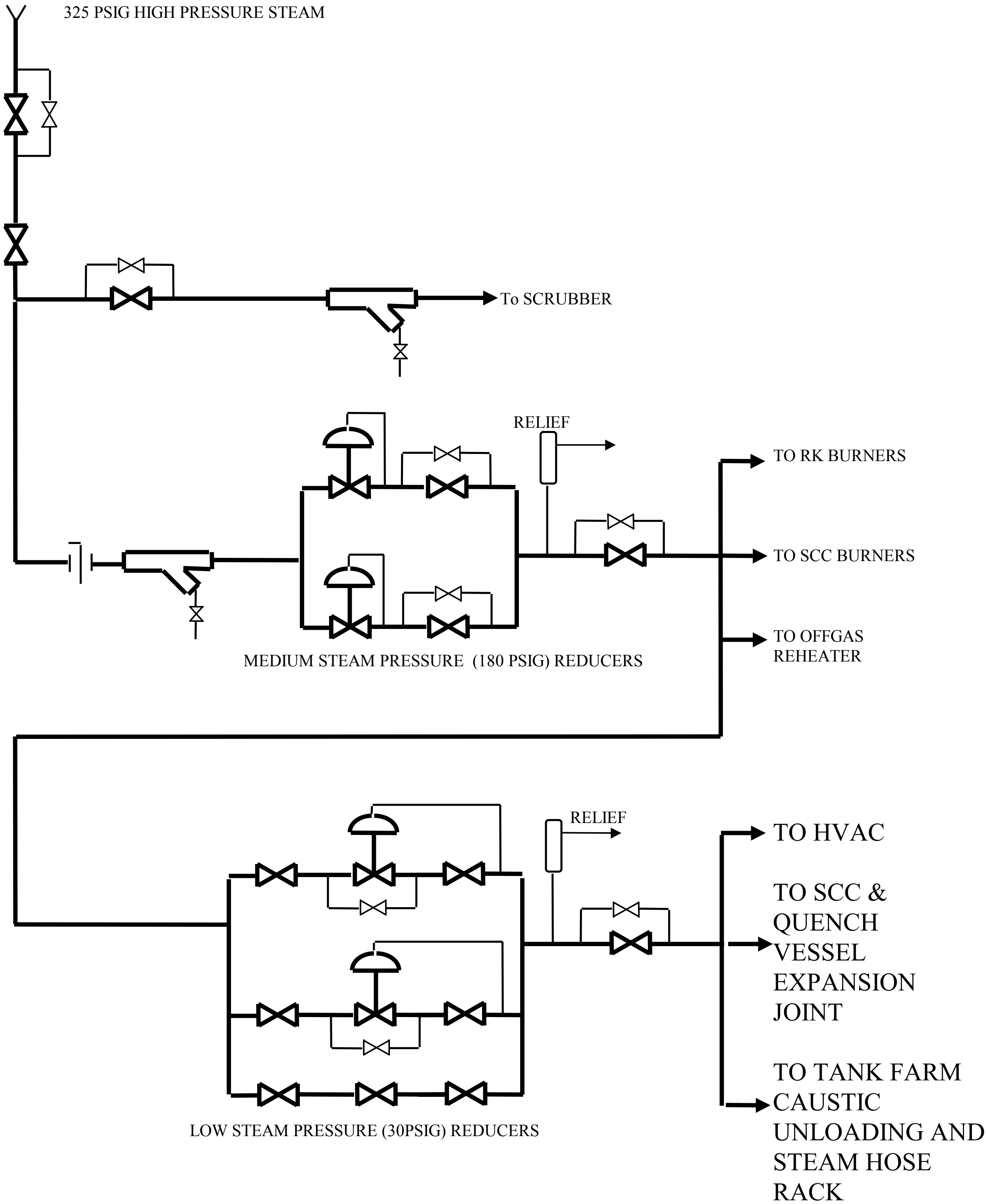

Figure 6 RK Steam Distribution System

Pressure and flow instrumentation send signals to the DCS, which controls steam pressure and flow. The DCS also controls the differential pressure between the atomizing steam and the fuel oil. DCS provides the following pressure/flow alarms and controlling actions:

CONDITION	ALARM	CONTROL ACTION
Supply press = 130 psig Controlled press = 110 psig	Hp Alarm Hp Alarm	
Supply press = 80 psig Controlled press = 5 psig	Lp Alarm Lp Alarm	
Desired D/P 25-35 psid .5 psid	LDP Alarm	Steam supply valve adjusts steam pressure equal to fuel oil pressure (up to 100 psig)
Flow = 12.6 lb/hr	Low Flow Alarm	

Table 3 Atomizing Steam/Fuel Oil

DCS also provides control of the steam purge valve for the fuel oil gun. When "Steam Purge" is manually selected, the steam purge valve is opened, and the fuel oil block valve is closed.

Burner sealing steam is provided through the same steam control and block valves as atomizing steam, but has no automatic or remote control functions.

RK Liquid Waste Burner

Pressure and flow of atomizing steam to the RK liquid waste burner is monitored by the DCS. Monitoring instruments are located in the steam lines at the RK remote skid.

Pressure and flow instrumentation send signals to the DCS, which controls steam pressure and flow. The DCS also controls the differential pressure between the atomizing steam and liquid waste. DCS provides the following pressure/flow alarms, and controlling actions:

CONDITION	ALARM	CONTROL ACTION
Press = 150 psig	Hp Alarm	
Press = 90 psig	Lp Alarm	
Press = 80 psig	Low Low Press Alarm	Interlock blocks admission of waste liquid to burner
Steam press not equal to 120 psig		Controls adjust regulating valve to achieve outlet pressure of LW psig
Flow = 20 lb/hr	Low Flow Alarm	

Table 4 Atomizing Steam/Liquid Waste Oil

DCS also provides control of the steam purge valve for the liquid waste burner. When "Steam Purge" is manually selected, the steam purge valve is opened, and the liquid waste block valve is closed.

Burner sealing steam is provided through the same steam control and block valves as atomizing steam, but has no automatic or remote control functions.

RK Aqueous Waste Nozzle

Pressure and flow of atomizing steam to the RK aqueous waste nozzle are monitored by the DCS. Monitoring instruments are located in the steam lines at the RK remote skid.

Pressure and flow instruments send signals to the DCS, which controls steam pressure and flow. The DCS also controls the differential pressure between the atomizing steam and the aqueous waste. DCS provides the following pressure/flow alarms and controlling actions:

CONDITION	ALARM	CONTROL ACTION
Press = 150 psig	Hp Alarm	
Press = 100 psig	Lp Alarm	
Press = 80 psig	Low Low Press Alarm	Interlock blocks admission of aqueous waste to nozzle
Steam press not equal to 120 psig		Controls adjust regulating valve to achieve an outlet pressure of 120 psig
Flow = 40 lb/hr	Low Flow Alarm	

Table 5 Atomizing Steam/Aqueous Waste

DCS also provides control of the steam purge valve for the aqueous waste nozzle. When "Steam Purge" is manually selected, the steam purge valve is opened, and the aqueous waste block valve is closed.

Nozzle sealing steam is provided through the same steam control and block valves as atomizing steam, but has no automatic or remote control functions.

Low-Pressure Steam Header

The low pressure steam header is supplied by the Medium-Pressure Steam System through an automatic pressure regulator and manual bypass valve. DCS monitors the header pressure and alarms at a High/Low pressure of 33 and 25 psig, respectively.

Tank Farm

The low-pressure steam lines feeding the Blend Tank Area, Caustic Unloading, and Regulated Unloading Area have no control functions or alarms associated with their service.

SCC and Quench Vessel

The Low Pressure-Steam System is further reduced and regulated by an automatic pressure reducing valve. The steam is supplied to the SCC and Quench Vessel expansion joints at less than 14 psig. These stainless steel vertical expansion joints can move both radially and axially. Steam is supplied as a continuous purge providing cooling to the joints and cleaning of any deposits that may collect in the joints which restrict proper expansion and contraction.

Building HVAC

The 2-inch low-pressure steam line feeding the Incinerator Building has five 1-inch branch lines which supply five (5) local area unit heaters in the Box Handling Area. The 2-inch header also supplies the incinerator main HVAC unit preheat coil via a temperature control valve with a remote setpoint of 49°F. The heated air is supplied to the Ashout, Kiln Feed, and Container Handling Areas.

Condensate

The Condensate System is not monitored or controlled. It functions only as a drain collection system for the condensed system steam.

System Shutdown

The Steam System will be shut down in accordance with procedure 261-SOP-MST-01, *Main Steam and Condensate*. The practice of taking steam loads offservice prior to Steam System Shutdown is consistent with Conduct of Operations practice and 261-GOP-05, *Process Shutdown From Warm Standby to Cold Standby (U)*, and will prevent any adverse effects on other systems caused by premature shutdown of the Steam System. After the operator receives the initiating cue from the Shift Supervisor to shut down the system, the first step is to close the main header isolation valve. Next, Radiological Control Organization (RCO) is notified that water and steam will be released to the area; after which a leak collection system is connected to the system blowdown valves. All the blowdown valves are slowly opened to purge the system of any residual steam and condensate. Following completion of these steps, the operator notifies the Shift Supervisor that the system has been isolated and drained.

In some areas, the steam header does not have sufficient slope to ensure complete drainage of the condensate. A line that is potentially blocked or that cannot be completely drained neither should be shut down nor should have heat tracing energized during freezing weather.

Infrequent/Abnormal Operations

Abnormal operations of the Steam and Condensate System encompass the events addressed in 261-AOP-MST-01, *Steam Events*. Symptoms of these events are listed below:

4.02	**DETERMINE both the specific effects to the Steam and Condensate System and the general overall integrated plant response to all of the following:** **a. abnormal system indications** **b. plant or system alarms** **c. operator initiated actions** **d. component malfunctions** **e. component failures**

Component Failure (occurring in any of the following):

- Failures of the steam supply piping to the RK or SCC Guns, the Scrubber, Offgas Reheater, Tank Farm, HVAC System, SCC and Quench Vessel Expansion Joints
- HVAC system heating coils
- Inadvertent vacuum formation (from the condensing action of steam) at the scrubber inlet
- Reheater coils

Annunciation (of any of the following):

- Alarms on DCS Point Tag Display OGS3006FC-1, OGS STEAM FLOW CONTROL
    1. LO LO OGS STEAM FLOW (3006FA)
    2. LOW OGS STEAM FLOW (3006FA)
- LOW OGS STM PRES (3007PA), on DCS Point Tag Display OGS3007 P-1, OGS STEAM PRESSURE
- LOW STEAM PRESSURE (5854PA), on DCS Point Tag Display MST5855P-1, MAIN STEAM PRESS/TEMP
- LOW PLANT STM PRESSURE (5855PA), on DCS Point Tag Display MST5855P-1, MAIN STEAM PRESS/TEMP
- HIGH PLANT STM PRESSURE (5854PA-1), on DCS Point Tag Display MST5855P-1, MAIN STEAM PRESS/TEMP
- LOW UTIL STM PRESS (5859PA), on DCS Point Tag Display MST5861F-1, MAIN STEAM FLOWS
- HIGH UTIL STM PRESS (5859PA-1), on DCS Point Tag Display MST5861F-1, MAIN STEAM FLOWS

Automatic Actions (associated with upset events)

- LOW-LOW steam flow to scrubber trips the incinerator on interlock
- LOW-LOW steam differential pressure to RK Fuel Oil Burner initiates incinerator shutdown

- LOW-LOW steam differential pressure to RK Waste Oil Burner initiates incinerator shutdown

- LOW-LOW steam differential pressure to RK Aqueous Waste Nozzle initiates incinerator shutdown

- LOW-LOW steam differential pressure to SCC Fuel Oil Burner initiates incinerator shutdown

- LOW-LOW steam differential pressure to SCC ROW Burner initiates incinerator shutdown (ROW Burner steam pressure [62-102 psig]) 2718PG. Nominally steam header pressure should be 30 psi above Row header pressure)

Design Features (to lessen the effects of upset events)

In the event of a failure of the steam flow control valve to the scrubber, the Low-Low steam flow interlock shuts down the incinerator.

The steam supply to the Medium-Pressure Steam System has redundant PRVs. In the event of a failure, place the standby steam supply pressure reducing valve online and isolate the failed valve.

The steam supply to the Low-Pressure Steam System has redundant PRVs. In the event of a failure, place the standby steam supply pressure reducing valve online and isolate the failed valve.

Summary

- The startup evolution is the most critical period in the operation of a Steam Distribution System. The Steam System will be started up in accordance with procedure 261-SOP-MST-01, *Main Steam and Condensate*. This procedure must be followed verbatim to prevent the possible catastrophic failure which could be caused by water hammer or thermal shock.

- Under Normal Operations, monitoring of the system for steam temperature and pressure is accomplished by the DCS in order to incorporate control and interlock functions.

- The practice of removing any equipment or systems from service which use steam, prior to securing the Steam System, is consistent with Conduct of Operations practices. This practice prevents any adverse effects on other systems caused by premature shutdowns of the Steam System. Leakoff collection systems are connected to system blowdown valves. Next, all the blowdown valves are slowly opened to purge the system of any steam and condensate remaining in the system lines.

- Abnormal Operations of the Steam and Condensate System encompass the events addressed in 261-AOP-MST-01, *Steam Events*.

- Guidance for the alarm conditions associated with the steam systems are given in the ARPs.

Appendix A

Table 6 Steam and Condensate System Instrumentation

CLI NUMBER	SETPOINT	SETPOINT DESCRIPTION
H-261-MS-PSL-2008	90 psig	RK AW Steam Pressure LOW
H-261-MS-PT-2008	0-200 psig	RK AW Steam Pressure
H-261-MS-PSLL-2011	150 psig	RK AW Steam Pressure HIGH
H-261-MS-PSLL-2011	80 psig	RK AW Steam Pressure LOW-LOW
H-261-MS-PS-2012	150 psig	RK AW Steam Pressure HIGH
H-261-MS-PS-2012	80 psig	RK AW Steam Pressure LOW-LOW
H-261-MS-FSL-2013	40 lb/hr	RK AW Steam Flow Rate LOW
H-261-MS-FT-2013	0-100 in WC	RK AW Steam Flow Rate (D-P)
H-261-MS-PS-1502	110 psig	RK FO Steam Pressure HIGH
H-261-MS-PS-1502	5 psig	TK FO Steam Pressure LOW
H-261-MS-PSL-1504	5 psid	RK FO Steam Pressure Diff LOW
H-261-MS-PSLL-1506	130 psig	RK FO Steam Pressure HIGH
H-261-MS-PSLL-1506	80 psig	RK FO Steam Pressure LOW LOW
H-261-MS-FSL-1510	12.616/hr	RK FO Steam Flow Rate LOW
H-261-MS-PU-1515	113 psig	RK FO Steam Pressure Regulator
H-261-MS-FSL-1601	20lb/hr	RK WL Steam Flow Rate LOW
H-261-MS-PIL-1604	120 psig	RK WL Steam Pressure LOW
H-261-MS-PSL-1604	90 psig	RK WL Steam Pressure LOW
H-261-MS-PS-1607	80 psig	RK WL Steam Pressure LOW LOW
H-261-MS-PS-1607	150 psig	RK WL Steam Pressure HIGH
H-261-MS-PS-1610	135 psig	RK WL Steam Pressure HIGH
H-261-MS-PS-1610	100 psig	RK WL Steam Pressure LOW
H-261-MS-PAH-2202	150 psig	SCC FO Steam Pressure HIGH
H-261-MS-PAL-2202	50 psig	SCC FO Steam Pressure LOW
H-261-MS-PT-2204	0-200 psig	SCC FO Steam Pressure
H-261-MS-PSL-2204	20 psid	SCC FO Steam Diff Press LOW
H-261-MS-PDS-2206	35 psid	SCC FO/Steam Diff Press HIGH

Table 6 Steam and Condensate System Instrumentation (Cont.)

CLI NUMBER	SETPOINT	SETPOINT DESCRIPTION
H-261-MS-PDS-2206	25 psid	SCC FO/Steam Diff Press L-LOW
H-261-MS-FSL-2210	20 lb/hr	SCC FO Steam Flow Rate LOW
H-261-MS-FT-2210	0-100 in WC	SCC FO Steam Flow Rate (D-P)
H-261-MS-FSL-2301	12.6 lb/hr	SCC RO Steam Flow Rate LOW
H-261-MS-FT-2301	0-100 in WC	SCC RO Steam Flow Rate (D-P)
H-261-MS-PSL-2304	20 psid	SCC RO Steam Diff Press LOW
H-261-MS-PT-2304	0-200 psig	SCC RO Steam Pressure
H-261-MS-PDS-2307	40 psid	SCC RO/Steam Diff Press HIGH
H-261-MS-PDS-2307	20 psid	SCC RO/Steam Diff Press L-LOW
H-261-MS-PAH-2310	110 psig	SCC RO Steam Pressure HIGH
H-261-MS-PAL-2310	25 psig	SCC RO Steam Pressure LOW
H-261-LS-PV-2406	6 psig	SCC Steam Press. Reg Valve
H-261-HS-FSLL-3006	6000 lb/hr	Steam to Scrubber Flow LL
H-261-HS-FSL-3006	7000 lb/hr	Steam to Scrubber Flow L
H-261-HS-FT-3006	0-300 inwc	Scrubber Steam Flow
H-261-OGS-PSL-3007	200 psig	Steam to Scrubber Press LOW
H-261-HS-PT-3007	0-300 psig	Scrubber Steam Pressure
H-261-OGE-TSL-3401	220°F	Reheater Out Temperature L
H-261-OGE-TSH-3401	260°F	Reheater Out Temperature H
H-261-OGE-TSHH-3401	265°F	Reheater Out Temperature HH
H-261-OGE-TT-3401	200-270°F	Reheater Outlet Temperature
H-261-MS-PV-5852	180 psig	OSOH Steam Valve Press. Reg.
H-261-MS-PV-5853	180 psig	OSOH Steam Valve Press. Reg.
H-261-MS-PAH-5851	190 psig	Steam HIGH Pressure
H-261-MS-PAL-5851	175 psig	Steam LOW Pressure
H-261-HS-PSL-5855	230 psig	LOW Steam Pressure

Table 6 Steam and Condensate System Instrumentation (Cont.)

CLI NUMBER	SETPOINT	SETPOINT DESCRIPTION
H-261-HS-PT-5855	50-350 psig	Steam Pressure
H-261-LS-PV-5857	30 psig	OSOH Steam Valve Press Reg.
H-261-LS-PAH-5859	33 psig	Steam HIGH Pressure
H-261-LS-PAL-5859	25 psig	Steam LOW Pressure
H-261-HS-TT-5860	350-600°F	Steam Temperature

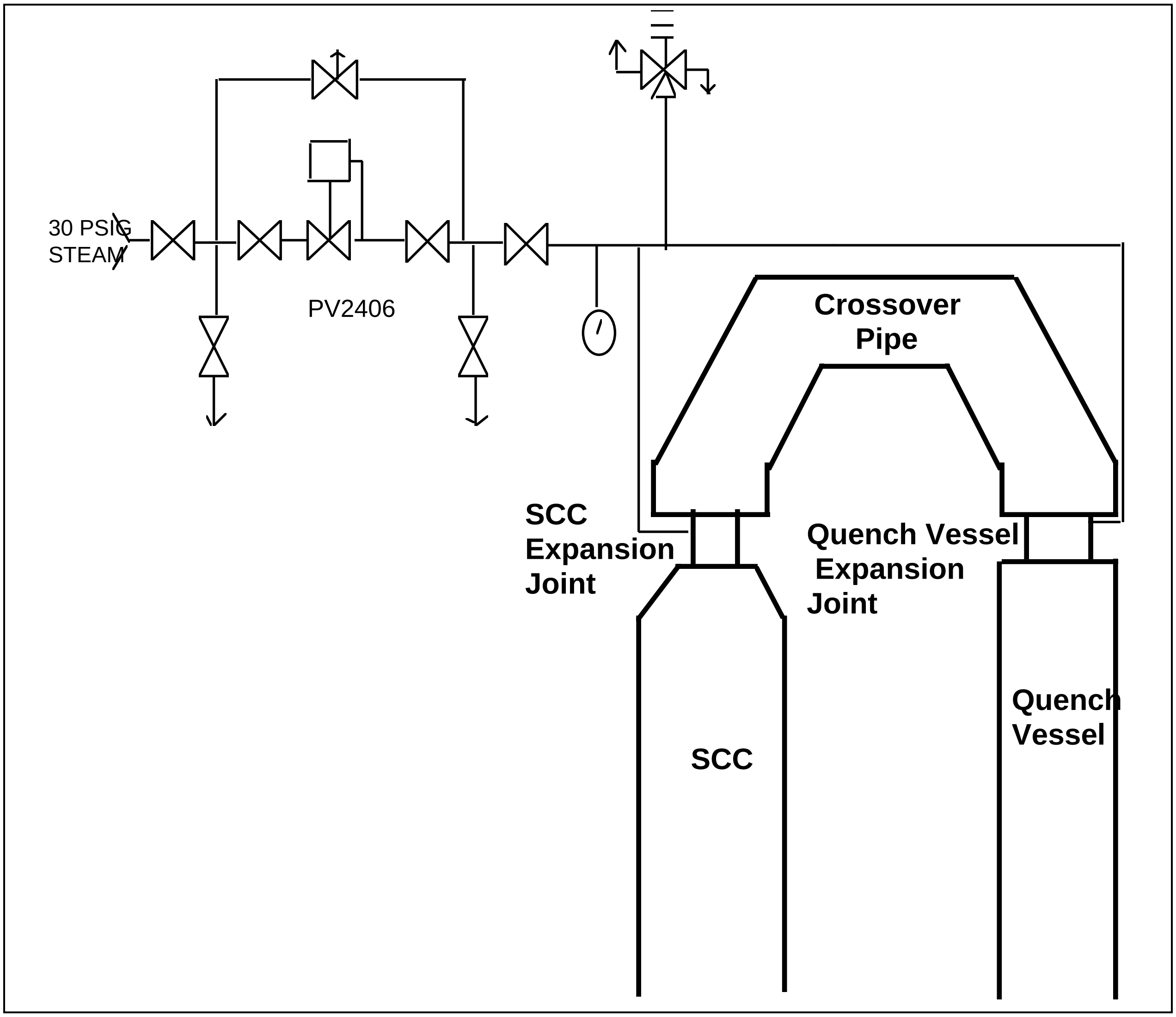

Figure 7 Expanion Joint Steam

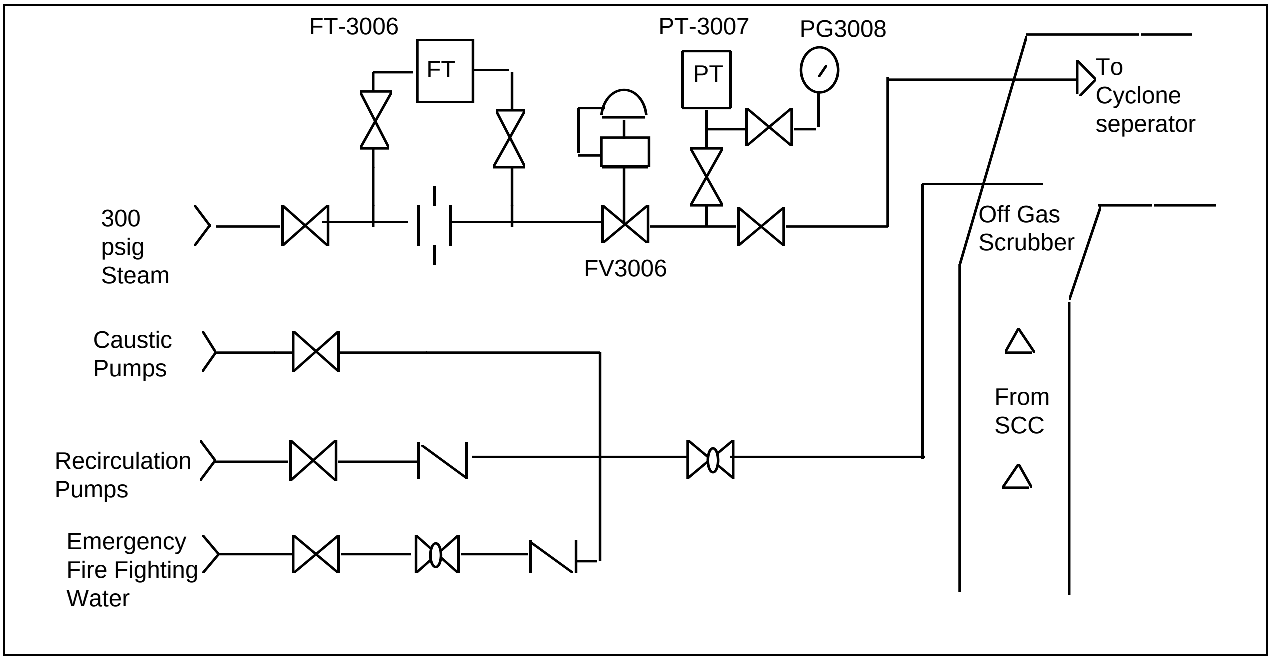

Figure 8 Offgas Scubber

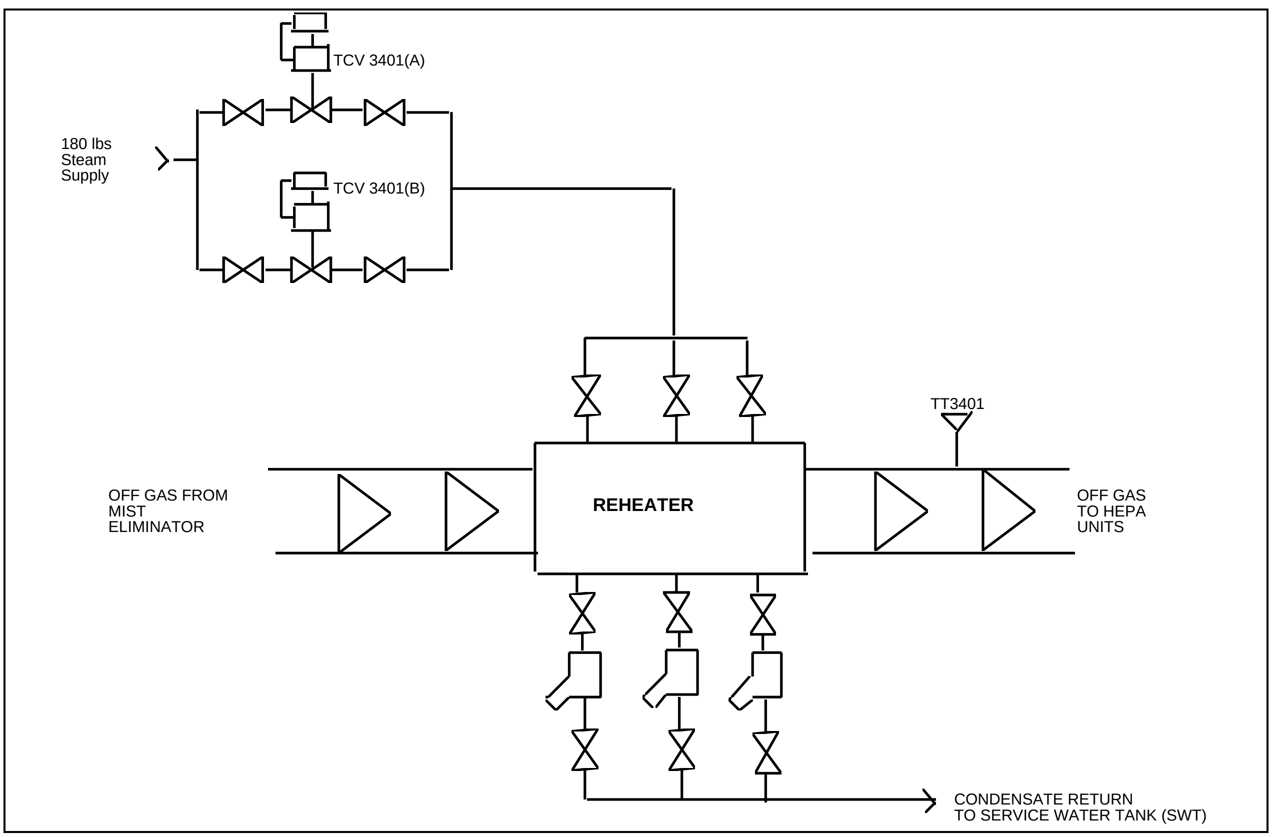

Figure 9 Offgas Reheater

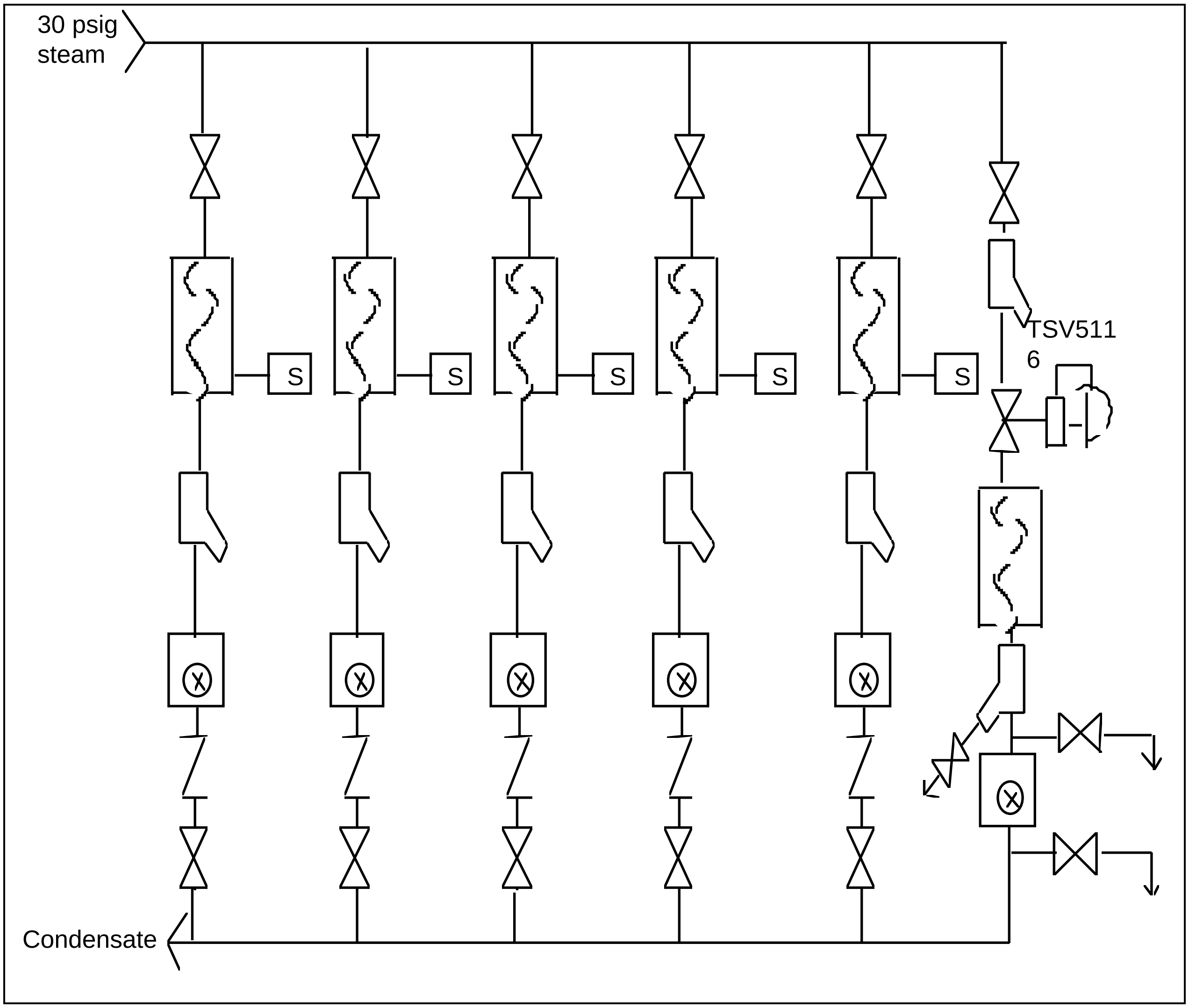

Figure 10 HVAC Steam

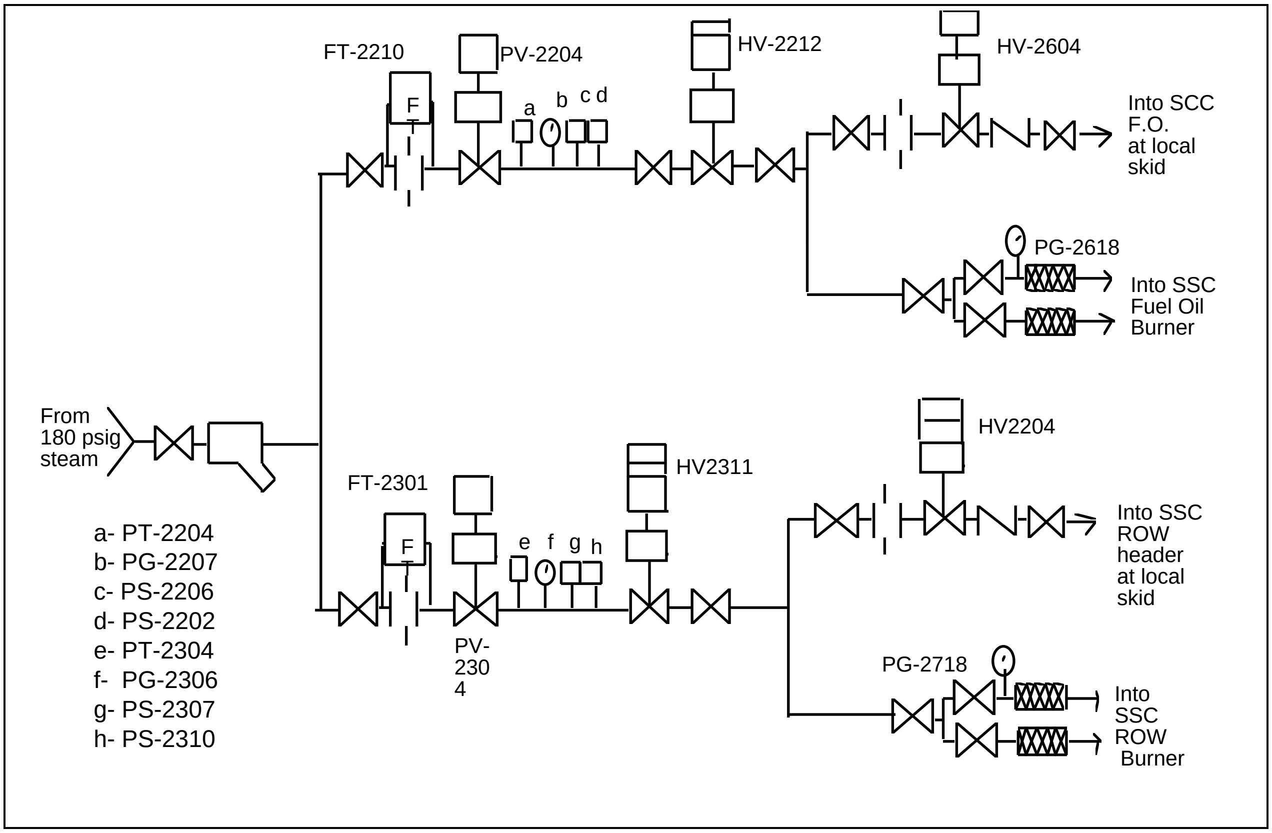

Figure 11 SCC Steam Distribution System